The Motion Analysis Research Center (MARC) at Samuel Merritt University (SMU) is a 2,000 ft², state-of-the-art laboratory located on the Oakland campus of Samuel Merritt University (SMU) and is designed to advance the scientific study of human motion in education, research and patient care. The MARC, consisting of a main data capture room with four separate research suites, changing facilities, storage, and the director’s office, provides faculty and students with the opportunity to study human motion by means of such equipment as a nine-camera motion capture system (Qualisys) capable of tracking whole-body human motion with sub-millimeter accuracy. This system synchronizes with two force platforms (AMTI) installed in the floor of the MARC as well as electromyography sensors (Delsys) that can monitor up to 16 individual muscles during movement. Taken in combination, researchers in the MARC are able to not just describe in detail human motion but understand the underlying mechanical and neuromuscular causes of the observed motion. The MARC also has two separate foot pressure mapping systems including a platform system with synchronized cameras (Novel) and a portable in-shoe system (Tekscan), allowing researchers to systematically study foot-floor pressures as well as pressure related issues in the foot-shoe interface. The latter is particularly of interest to podiatry researchers seeking to use evidence-based techniques to ensure the best clinical outcome in orthotic prescription. For researchers interested in human gait, the MARC contains a 26’ instrumented walkway (Zenos) for the temporal-spatial analysis of walking. Although housed in a purpose-designed research suite in the MARC, this system is capable of being easily transported to other locations, giving researchers the flexibility of collecting data where it is most convenient for the target population. The MARC also houses the Balance Master (Neurocom), a sophisticated balance testing system that provides objective assessment and retraining of the sensory and voluntary motor control of balance with visual biofeedback on either a stable or unstable support surface and in a stable or dynamic visual environment. Healthcare practitioners across several fields will use the MARC to study biomechanics, gait, upper and lower body movement, the efficacy of treatment modalities, and apply what they learn in clinical practice for the benefit of patients. The MARC will also be used for clinical trials of new products to treat movement disorders. The laboratory will serve as a teaching center on motion analysis for faculty and students from SMU’s California School of Podiatric Medicine (CSPM), Department of Occupational Therapy (OT), and Department of Physical Therapy (PT).

The MARC is unique amongst other similar laboratories in that: a) it involves the partnership of three separate clinical disciplines (CSPM, OT, PT); b) it is a university-wide, rather than a departmental, resource; and c) it exists within a not-for-profit health system (Sutter Health). While laboratories dedicated to the study of human motion are not unique, most fall into one of two broad categories. The first category includes laboratories that exist within a single academic department, which is case in such examples as CSU-Fresno (Kinesiology), USSF (PT), SDSU (Exercise and Nutritional Science) or CSU-San Marco (Kinesiology). Generally, these laboratories support the scholarship activities of faculty of those departments and their research partners. The second category occurs when the laboratory is a joint venture with a medical facility and a university, as is the case at UCLA (Kameron Gait and Motion Analysis Laboratory) or CSU-Dominguez Hills (VA). The MARC at SMU is a university resource with access to the member disciplines of Sutter Health comprising doctors, hospitals, and other health care services in more than 100 Northern California cities and towns. In addition, faculty conducting their research in the MARC will be able to forge partnerships with other academic institutions, clinics and hospitals, and independent clinicians in the region.

The MARC serves as a focus for clinical research and teaching within three inter-related themes: a) Foundations of Clinical Practice; b) Evidence-based Clinical Teaching and Practice; and c) Clinical Innovations and Applications. Under the first theme, researchers will design research protocols to investigate the efficacy of fundamental methods of treatment and prevention, the benefits of which may be controversial. Combining evidence-based research and teaching is the goal of the second theme, while the third theme allows for researcher in the MARC to participate in cutting-edge applied research that could involve innovative treatment methods or devices. Taken together, these themes offer ample opportunities collaborations within the SMU MARC founding disciplines as well as with other SMU clinical
disciplines and research partners in Sutter Health, other universities, and companies supporting clinical practice.

SMU is actively seeking partnerships to fully exploit the potential of the MARC and, as such, Sutter Health physicians would naturally be high on the list of these partners. Sharing common interests in human movement and neuromuscular performance, the MARC could play an important role in the diagnosis, treatment, and prevention of conditions affecting patients of Sutter Health physicians. Referrals of patients to the MARC would clearly fit within the basic themes of the MARC, enhancing current diagnoses and treatments, as well as exploring novel and innovative intervention strategies. It would also offer Sutter Health physicians opportunities to publish findings of collaborative research projects.

As the MARC does not ‘belong’ to any single clinical discipline, and it exists to exploit multi- and interdisciplinary research and teaching, it offers Sutter Health a unique resource for the study of human motion and performance unlike anything currently existing within the network. In particular, a service such as orthopedics would benefit from the resources of the MARC at SMU, in particular with respect to joint replacement, reconstruction, and repair, sports medicine, and physical therapy and rehabilitation. The MARC is ideally able to contribute to pre- and post-surgical assessments, as well as ongoing monitoring of patients’ progress and patient education. The MARC could also have a role to play in neurology clinical trials as a testing center of neuromuscular function.

The MARC is conveniently located in Oakland, next door to Alta Bates Summit Health Center. The current director, Professor Drew Smith, selected from a global search, is an expert in human motion analysis with more than 35 years of experience, which includes research and teaching roles in both universities and hospitals. He has worked with, and mentored, colleagues in podiatry, OT, and PT previously as well as having worked with bioengineers, orthopaedic surgeons, physiatrists, nurses, and other disciplines throughout the world. Professor Smith’s research interests include gait and balance, as well as the application of biomechanics to sports medicine. He is particularly interested in evidence-based musculoskeletal and neuromuscular clinical interventions and prevention strategies. Currently, there are a number of collaborative research projects in development or being conducted in the MARC, including the following:

- The effect of chronic ankle instability on the biomechanics of planned and unplanned turns in normal gait.
- An investigation of the roles of vision, base of support, and ankle joint stiffness on balance in normal and perturbed human standing.
- Treatment of flatfoot using a unique engineered sock.
- Evaluation of the workstation ergonomics of a pedestal-type seating system.
- Designing injury prevention orthotics for adolescent female athletes at risk for anterior cruciate ligament damage.
- Three-dimensional biomechanical analyses of gait initiation and termination in healthy, young subjects.
- Physical exposure to musculoskeletal disorders in hotel room cleaners with the increased prevalence of large, luxurious mattresses.